Revised Expert Report of Ken Fucik

January 2008

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Enoch Adams et al. v. Teck Cominco Alaska Incorporated

Summary

In summary, my opinions are:

- Teck Cominco committed violations of its NPDES permit for total dissolved solids, cyanide, and whole effluent toxicity (WET) at the Red Dog Mine between August 1998 and August 2007.

- These violations occurred as a result of Teck Cominco's failures to adequately treat the discharge from the mine, and allowed release of contaminants that were environmental as well as human health risks.

- Releases of contaminants from the Red Dog Mine caused increased loading of contaminants to the environment which likely contaminated both waters and sediments.

- As a result of the unlawful releases, the ecological system downstream from the mine was injured and the citizens of Kivalina were exposed to contaminated fish and drinking water.

- Teck Cominco performed inadequate studies to identify and address the environmental and human health risks to the region.

In forming my opinions, in addition to the sources mentioned in this report and in the references section at the end, I have reviewed:

- Expert reports of Kevin Brix, Joyce Tsuji, Gene Andrews, and Michael Botz.

- Various EPA Guideline documents dealing with WET testing and regulations relating to the Clean Water Act.

- EPS Integrated Risk Information System.

- National Water Quality Criteria guidance documents.

- EPA Guidance for Assessing Chemical Contaminant Data for Use In Fish Advisories.

- Technical reports provided in the reference section at the end of this report.

- Discharge Monitoring Reports (DMRs) reports from the Red Dog Mine, 1998-2007.

- Laboratory reports from the Red Dog Mine's labs from testing for TDS, cyanide and whole effluent toxicity, 1999-2007.

- Expert reports prepared by Dr. Robert Moran.

• Documents filed by Teck Cominco in this lawsuit and discovery responses provided by Teck Cominco.

Qualifications

I am a specialist in water quality and aquatic toxicology. I was founder of The SeaCrest Group which I managed for almost 20 years before selling the company. I hold a Bachelor of Science degree in Zoology from Texas Tech University and a Master of Science in Biological Oceanography from Texas A&M Univesrity. I was also a founder of Envirolab Peru , an environmental chemistry laboratory in Lima, Peru. I was President of the Board of Directors of Envirolab prior to selling my interest in 2006.

I have more than thirty-five years of domestic and international experience in conducting and managing environmental studies for industrial and municipal clients, law firms, and government agencies. I have performed laboratory and field studies on the effects of organic and inorganic contaminants in freshwater and marine environments. These studies have investigated impacts of permitted and accidental discharges from mines, oil and gas wells, refineries, power plants, manufacturing facilities and municipal wastewater plants, among others.

I have taught courses to technical and general audiences, and have given expert testimony on various types of projects. I have worked on projects in Australia, Argentina, Mexico, Peru, Great Britain, Russia, Equatorial Guinea, Colombia, Indonesia, Bangladesh, Omar, and the United States.

In my current assignment, I am responsible for all environmental permitting activities associated with construction and operation of a multibillion dollar oil and gas project in the Middle East. I have provided expert technical support to investigate the environmental and human health effects of organic and inorganic contaminants on surface waters following a gas well blowout in Bangladesh. I have investigated the transport and fate of metals and hydrocarbons in surface waters of the Peruvian Amazon. I have studied the effects of oil and dispersed oil on fish and invertebrates of the Java Sea, Indonesia. In the North Sea, I have investigated the food chain effects of contaminants in cuttings piles. For a multibillion dollar industrial project in Russia, I have been involved in developing the construction and operations monitoring plans.

I have conducted and/or directed thousands of biomonitoring studies at mining and industrial sites across the United States. As part of these investigations, I have directed projects supporting the design of water treatment facilities for operating mines and those undergoing Superfund cleanups, including the Argo Tunnel and Summitville Mines in Colorado. I also conducted studies to support engineers involved in designing a treatment process for metals contaminated effluents at the Rocky Mountain Arsenal. I have also directed and conducted biomonitoring tests under NPDES guidelines for numerous metals mines and coal mines in Colorado, South Dakota, Utah, Nevada, and Idaho. I was appointed to a citizens committee to advise county and state government on designation of Superfund status for a historic mining district in the Lefthand Watershed, Colorado. I am a past member of the board of the Lefthand Watershed Oversight Group advising EPA and the Colorado Department of Public Health and Environment on ongoing studies in the watershed. I have collected water samples within this and other watersheds which were used in biomonitoring testing to

determine the effects of acid mine drainage from abandoned mining operations.

Additionally, I have conducted numerous investigations to identify causes of toxicity associated with high total dissolved solids (TDS) concentrations. These studies have been conducted for mines, municipalities, refineries, produced water discharges from oil and gas wells, and for water treatment facilities using membrane technology under funding from the American Waterworks Research Foundation.

I have worked for numerous companies such as the Minerals Management Service, Bureau of Reclamation, Kennecott Copper, Pluspetrol, London Mining Venture, Colorado Oil and Gas Commission, Asarco, RTG, Rocky Mountain Arsenal, U.S. Forest Service, Unocal, Occidental, Anadarko, Sunnyside Mining Company, ExxonMobil, Shell, Mountain Coal, Mid Continent Mining Company, Amax, Anaconda, Rocky Flats Environmental Technology Center, Eastman Kodak, CH2MHill, ERM, Versar, Lockheed Martin, Pueblo Munitions Depot, URS, Evergreen Resources, Union Pacific, Chevron, Petroperu, Perez Companc, and numerous municipalities in Colorado, New Mexico, Florida, Texas, Arizona, and North Dakota.

I have authored and co-authored scientific papers published in refereed journals dealing with the effects of contaminants in aquatic environments. I have prepared numerous environmental impact assessment reports for industrial operations in Peru, Argentina, Turkey, Bangladesh, and the United States. These reports have been prepared for activities in both aquatic and terrestrial environments. I have authored hundreds of reports detailing the results of WET testing of discharges from industrial and municipal operations. I have also conducted and reported on the results of sediment toxicity tests to determine the effects of industrial discharges. I have taught courses on aquatic toxicology and the effects of contaminants and presented scientific papers on these topics in both the U.S. and abroad. I have also been a reviewer of papers dealing with aquatic toxicology for the Journal of Environmental Toxicology and Chemistry. I am currently directing a study to investigate the effects of acid mine drainage in the Lefthand Watershed and recently completed sampling and testing of discharges from abandoned mines in Gamble Gulch west of Boulder, Colorado.

A true and correct copy of my C.V. is attached. I am being compensated at $100.00 per hour for my testimony.

I have examined the NPDES permits for Teck Cominco's Red Dog mine and the Red Dog port site. I have also examined the Discharge Monitoring Reports (DMRs) for the mine and port sites from 1998 to July 2007. I have also reviewed many of the letters from Teck Cominco to EPA admitting exceedances of Teck Cominco's NPDES permits. I have also reviewed lab reports from ACZ, NCA and Test America for TDS and cyanide results of Outfall 001. I have also reviewed Teck Cominco's Revised Opposition to KRPC's Motion for Partial Summary Judgment, and the declarations Teck Cominco submitted supporting that Opposition in the related case Kivalina Relocation Planning Committee v. Teck Cominco Alaska, Inc., No. A02-231 CV(JWS).

Testimony relating to Red Dog Mine and Port

WET testing is a proven method for monitoring discharges from industrial and municipal operations. The EPA conducted interlaboratory testing of the WET methods and found that they have a high rate of successful completing, do not often produce false positive results, and exhibit precision comparable to chemical methods approved at 40 CFR part 136. The following table shows the results of this testing which was performed by 56 laboratories across the country. The lab which I manage was one of the labs to perform in this exercise.

Table 1. Summary of Performance Characteristics for Ratified WET Methods. (Taken from: Guidelines Establishing Test Procedures for the Analysis of Pollutants; Whole Effluent Toxicity Test Methods; Final Rule, [Federal Register: November 19, 2002 (Volume 67, Number 223)], [Rules and Regulations, [Page 69951-69972]

Test method	Successful test completion rate (%)	False positive	Interlaboratory precision (%CV) rate
Ceriodaphnia dubia Acute Test	95.2	0.00	29.0
Ceriodaphnia dubia Survival and Reproduction Test	82.0	3.70	35.0
Fathead Minnow Acute Test	100	0.00	20.0
Fathead Minnow Larval Survival and Growth Test	98.0	4.35	20.9

Teck Cominco has attempted to argue that failure of one of the two strains used for WET testing should not be considered noncompliance. However, not all aquatic species are equally sensitive to contaminants. This is demonstrated in the table below which shows that the invertebrate (*Daphnia*) is in most cases more sensitive than fish to metals by factors ranging from 2-3 times to more than an order of magnitude. The 96-hr LC50 measures the concentrations of a contaminant that is toxic to a test organism in a 96-hr exposure and is a common measure of toxicity. In the natural environment, any impacts on invertebrate communities can indirectly impact fish populations. That is why it is important to conduct WET tests using aquatic species of different types.

Table 2. 96-hr LD50 values in ug/l. [Taken from 1) Lankford, P.W. 1990. Removal of metals to nontoxic levels, pp 98-124. *In* Lankford, P.W. and W. Eckenfelder, eds. Toxicity Reduction in Industrial Effluents. Van Nostrand Reinhold, New York; 2) EPA ECOTOX Database; 3) USEPA Ambient Water Quality Criteria documents].

CONTAMINANT	FATHEAD MINNOW	*DAPHNIA*	*RAINBOW TROUT*
Arsenic	*15600*	*1348*	*13340*
Cadmium	*30.5*	*48.1*	*4.3*
Chromium (hexavalent)	*43100*	*6400*	*69000*
Copper	*115.5*	*21.2*	*42.5*
Lead	*5000*	*975*	*471000*
Mercury	*159*	*3.2*	*275*
Nickel	*440*	*54*	-
Selenium	*1460*	*430*	*9000*
Silver	*0.012*	*0.002*	*0.023*
Zinc	*238*	*100*	*590*

Federal regulation (40 CFR § 122.45(d)) requires that permit limits be expressed as an average monthly limit and a maximum daily limit. Chapter 5 of EPA's NPDES Permit Writer's Manual notes that "the daily maximum limitations are based on the assumption that daily pollutant measurements are lognormally distributed. Long-term average limitations are based on the distribution of averages of measurements drawn from the distribution of daily measurements. When designing a treatment system, EPA recommends that the permittee target the design of its treatment system to meet the long-term average rather than the daily maximum. The daily maximum is intended to account for variation in effluent concentration above the long-term average." A treatment system can be characterized by the long-term average (i.e. monthly average) and the variance (or coefficient of variation) and by assuming a particular statistical distribution (usually lognormal). Permit limits are generally set at the upper bounds of acceptable performance (Chapter 5 of the *NPDES Permit Writer's Manual*). Therefore, when a treatment system shows extreme upsets or varies widely around the long-term average, it is indicative of a poorly designed or operating system. In Teck Cominco's case, this was reflected in certain daily maximums that were so out of compliance that the monthly average was also violated.

The aquatic system in the vicinity of the Red Dog Mine is a naturally stressed system due to the Red Dog mineralization. Discharges from the mine add contaminants which further add to this stress. For instance, the mine discharges ammonia in concentrations which can be toxic to fish. Other discharged contaminants which add to loading in the stream system include total dissolved solids and some metals. Testing of the mine discharge has shown consistent toxicity to fish and invertebrates. This stress added to that of the already stressed natural system can be expected to further impact downstream habitats over and above what can be expected in the absence of the

discharge. This can be especially critical in periods of mine upsets.

Teck Cominco has consistently demonstrated a good correlation between conductivity and TDS measurements. Currently Teck Cominco measures conductivity downstream from the mine discharge, with TDS measurements at the pipe reported once a week. The TDS discharged from the mine is also much higher than the background levels in the aquatic system below the mine. Given these two factors, it is likely that fluctuations in TDS measurements at the mine will be reflected in conductivity measurements downstream.

Contaminants discharged in the Red Dog Mine effluent will enter downstream aquatic systems. These contaminants will represent a potential long-term source of contamination where they can impact aquatic communities and drinking water sources. Metal and cyanide(s) will be of particular concern in this regard.

Summary of Information Forming the Basis for My Opinions

The NPDES permit for the Red Dog 001 discharge includes numerical limits and monthly monitoring for pH, turbidity, hardness, aluminum, cadmium, copper, chromium, iron, lead, manganese, mercury, nickel, selenium, silver, zinc, total dissolved solids (TDS), total suspended solids, cyanide (total and WAD), fecal coliforms, total residual chlorine, BOD, and ammonia nitrogen. The permit also has a requirement to conduct whole effluent toxicity testing (WET).

Whole effluent toxicity testing (WET) has been used for almost 20 years as a means to measure and control toxic substances in NPDES permitted wastewaters from industrial and municipal discharges. The basis of WET testing was established in the Declaration of Policy and Goals of Section 101 (a)(3) of the Clean Water Act when it stated that "it is the national goal that the discharge of toxic pollutants in toxic amounts be prohibited". The WET test methods were codified by EPA in a final regulation on October 16, 1995 (60 FR 53529). The agency-approved methods are specified in 40 CFR 136.

The value of WET testing is that it allows for monitoring of discharges that are complex and have the potential to contain a wide range of contaminants that may or may not be individually present in toxic amounts. The final rule for WET testing in 40 CFR 136 stated that "effluent limitations on specific compounds do not necessarily provide adequate protection for aquatic life when the toxicity of effluent components is not known, effects of effluent components are additive, synergistic, or antagonistic, and/or when an effluent has not been chemically characterized".

Two recent papers document the presence of most of the constituents listed below in the Red Dog rocks (Slack et.al., 2004a and b). Other chemical constituents not mentioned in the Slack papers are listed below because they are almost always present in metal mine effluents. Confirmed and or/suspected constituents in the rocks include aluminum, antimony, arsenic, barium, cadmium, copper, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc, calcium, magnesium, sodium potassium, sulfate, nitrate, ammonia, boron, phosphorus, fluoride, chloride and natural radioactive constituents (e.g. uranium, thorium, potassium-40, and gross alpha and beta).

Chemical reagents used in processing of the ore include methyl isobutyl carbinol, potassium ethyl xanthate, sodium ethyl ether, potassium amyl xanthate, sodium isobutyl xanthate, sodium metabisulfite, zinc sulfate, copper sulfate, sodium cyanide, sodium sulfide, lime, sodium hydroxide, organic antiscalants and flocculents (correspondence: James Kulas, T-C to Enoch Adams, Jr., Oct. 11 and 13, 2002). About 155 tons per year of sodium cyanide is used and this generates numerous cyanide and related breakdown compounds (metal-cyanide complexes, cyanate, thiocyanate) as wastes. In addition, the mine utilizes large quantities of explosives (i.e. ammonium nitrate-fuel oil, dynamite, etc.) and fuels (diesel, gasoline, kerosene), oils and lubricants, the residues of which are routed into the mine wastes and then to the treatment plant.

Between 1998 and 2007, the mine discharge violated permit limits for total dissolved solids, cyanide, and cadmium. WET limits have also been violated during this period. Numerical and WET limits have been established for the mine on the basis of instream conditions so as to be protective of water quality and aquatic life. Therefore, when such limits are exceeded, it is reasonable to expect that injury to the natural system has occurred.

Whole Effluent Toxicity

I was employed by the SeaCrest Group, which I founded in 1987, and served as its General Manager. I have more than 35 years experience in the environmental field during which time I have specialized in water quality studies. Since its founding more than 20 years ago, SeaCrest has specialized in performing aquatic toxicological monitoring and investigations for municipal and industrial clients holding NPDES permits. The lab routinely performs whole effluent toxicity (WET) testing on over 400 discharges per year from numerous municipal and industrial facilities and/or operations. I have personally tested, reviewed data and written reports for literally thousands of WET samples. For those samples which have failed WET permit requirements, I have been involved in the conduct of hundreds of TIE/TRE investigations to identify the sources of toxicity. These investigations have been done to identify the causes of toxicity in municipal and industrial discharges that have included precious metals mining and coal mining, oil and gas exploration, production and refining, and manufacturing for metals, chemicals and military operations.

I was engaged as an expert witness to review data relating to the operations and discharges from the Red Dog Mine operated by Teck Cominco Alaska. In the course of this review, I have reviewed the declarations prepared by Kevin Brix, Mark Thompson (four different declarations), Edward Koon, and James Swendseid accompanying Teck Cominco's Opposition to Plaintiff's Motion for Partial for Summary Judgment, as well as that Opposition itself. I have also reviewed EPA documents including *Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods*, Office of Water, EPA 821-B-01-004, September 2001. I have also utilized the EPA ECOTOX database in my review of defendant's claims.

WET testing was implemented by the EPA to provide a more direct measure of the potential risks of industrial and municipal discharges on surface waters of the U.S. than can be provided simply from numerical measures of contaminant concentrations. Over the years since first being implemented as part of NPDES requirements, procedures have been standardized such that tests

involving *Ceriodapnia* and other species are fairly routine for labs specializing in WET testing. Today, these procedures are conducted at a level of variability that is consistent with approved analytical procedures and that provides good inter- and intralaboratory precision. The acceptability of such tests for regulatory compliance purposes was demonstrated by interlaboratory testing undertaken by EPA in response to a judicial challenge to the use of the WET procedures. The results of this testing was reported in a 2001 peer reviewed publication (*Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods*, Office of Water, EPA 821-B-01-004, September 2001). The results of EPA's interlaboratory program demonstrated that the *Ceriodaphnia* chronic test can be performed with an average coefficient of variation of 35%. Labs can further decrease this variability when necessary by addition of more test organisms, increased numbers of replicates, and addition of exposure concentrations. EPA's published procedures establish a minimum level protocol so such modifications to the prescribed procedures are acceptable under the guidelines and could have been implemented by Teck Cominco at any time during their testing.

There are over 200 labs in the U.S. that perform WET testing. For those labs doing routine WET testing, samples are typically received six days per week and test organisms are routinely maintained in cultures in the lab to be available on an as needed basis. Labs will ask clients to schedule when possible to facilitate workloads, but in 20 years, my lab has never refused a client's requests for short timeframe samples. With 24 hours notice of a sample's arrival, it is possible to have available test organisms from multiple commercial suppliers around the country for a specific discharge.

NPDES permits do not specify the dates that monitoring tests must be performed. Accordingly, a discharger can initiate a test at any time between the first and last day of the month to meet the requirement for completing a test. An acceptable test in the case of *Ceriodaphnia* is generally based on having at least 80% control survival and a certain number of neonates produced by the control organisms. At any time during the test when control survival goes below 80%, the test can be stopped and a new one initiated. A complete test will run for 7 days. If the 80% survival is achieved, the lab must then determine whether the required reproduction has been achieved. When time is if the essence, this determination can be made within an hour after completion of a test by a simple average. This allows sample collection to begin on the next day if it is necessary to begin a new test. In my lab's experience, we have frequently reported such results immediately upon completion of a test to clients who were concerned about meeting their NPDES reporting deadlines. While clients are always cautioned about oral results until a final report is prepared and reviewed, the acceptability parameters for a test are well established, straightforward and readily determined. This allows a rerun of the test to be done immediately in the event of a test not meeting the acceptability parameters.

Each of the above issues – control failures, inability to repeat tests within a single month, test organism availability, inability to schedule labs – have been cited by Teck Cominco as reasons for having failed to meet NPDES permit reporting and/or testing requirements. It is unreasonable for Teck Cominco to make such claims given the fact that labs have utilized all of the solutions described above for many years to facilitate meeting their client's NPDES requirements for both chemical and WET testing. In addition to being lax in its reporting requirements, Teck Cominco

has also failed WET tests at various times from 1999 to 2004 in chronic testing with *Ceriodaphnia*. Under the NPDES requirements, it is necessary to undertake a TIE/TRE when a sample has been shown to be toxic. The TIE/TRE is undertaken to identify the type and source of the contamination so that procedures can be implemented to eliminate the toxic substance or substances from being discharged. Teck Cominco has conducted such testing in the past but was only able to account for 50% of the observed toxicity. The 50% of the toxicity that was identified was attributed to TDS. This left 50% of the discharge containing toxicants that have not been identified to date in spite of much effort.

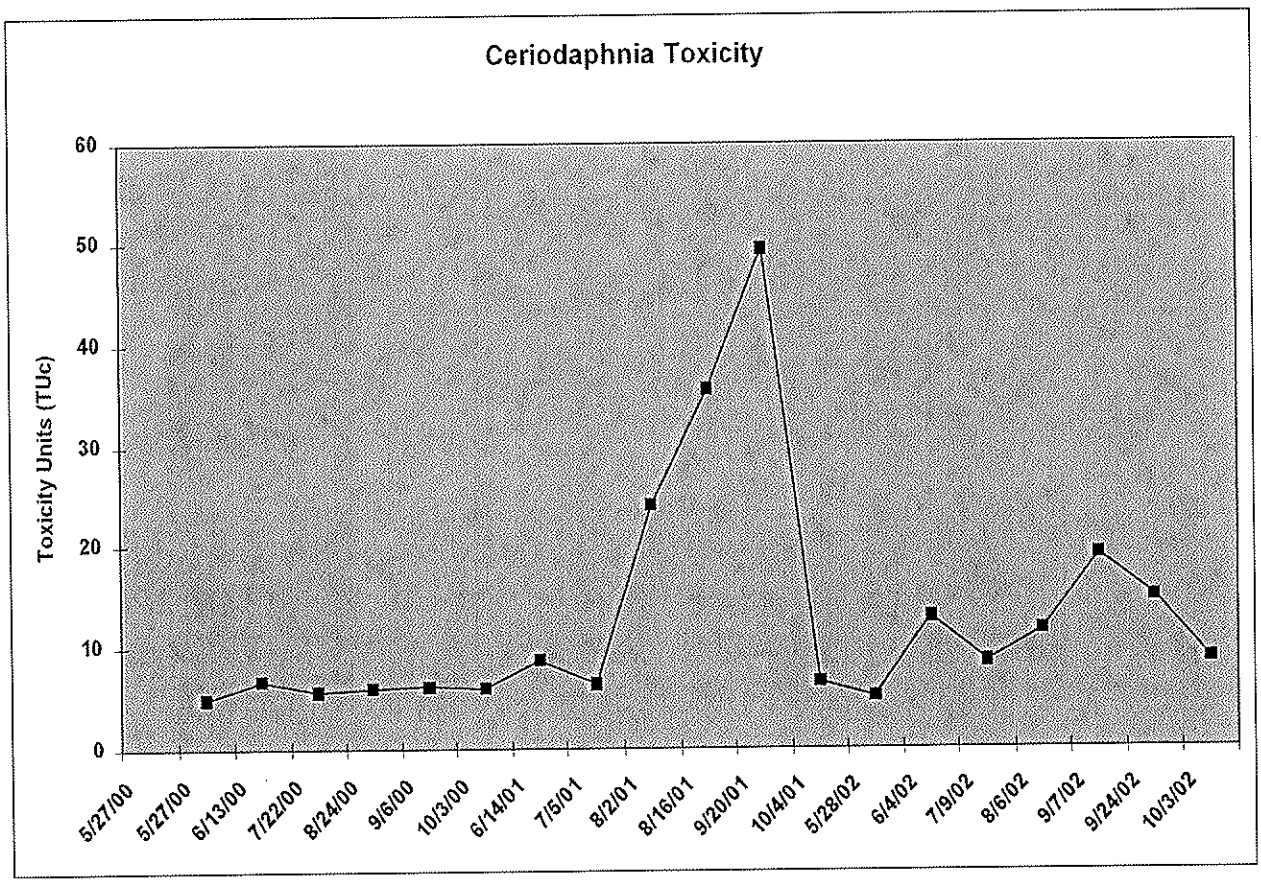
Test failures (i.e. permit exceedance) for the chronic *Ceriodaphnia* test occur when a statistically significant difference is measured in survival or reproduction. The Red Dog mine has been assigned a monthly average WET limit of 9.7 chronic toxic units (TUc). Put in perspective, 9.7 TUc's would represent a mixture comprised of approximately 10% mine discharge and 90% control or clean water. A sample which fails at this level is indicative of an end of pipe discharge that is highly toxic. Hence, there is a strong incentive to identify toxic components and remove these from discharge into surface waters where they are a threat to the environment and humans.

In failing to identify the cause of the toxicity, Teck Cominco is in violation of NPDES requirements to eliminate discharges of contamination. In addition, the Red Dog effluent has continued to demonstrate toxicity that exceeds established NPDES permit limits. The most recent case of a permit exceedance of which I am aware occurred in August 2004, on a sample of the Red Dog effluent that was split between two labs. The two labs reported 9.28 and 13.6 toxic units in the discharge sample. These compare to a monthly average permit specified WET limit of 9.7 chronic toxic units (TUc's). In other words, one was a definite failure of the permit requirements, the other marginally passed. Teck Cominco chose to report the marginally passing result on its DMR, while footnoting the failed test.

It is not unusual for dischargers to run split samples on a discharge but in my experience, it is not a practice that is encouraged by EPA for WET compliance testing. In my experience, dischargers do such splits when toxicity is expected in a sample. However, when split samples are run, it is not acceptable to pick and choose among the test results to determine which number is reported for NPDES compliance. At a minimum, both results should be reported equally with the assumption that the worst-case scenario will prevail until proven otherwise. In this case, Teck Cominco chose to report the lower toxicity value because, as Mr. Brix states, it "did not see any reason not to accept the ENSR results as accurately representing the toxicity of the effluent..." (Brix dec.,¶12). For his own test results, Mr. Brix made the same claim stating he had "no reason to believe that the results of the test I ran on the split sample did not accurately reflect the toxicity of the August 3, 2004 sample..." (Brix dec. ¶13). Instead of making the same claim for the sample which showed a permit exceedance, he stated that he did not "believe the CH2M Hill WET results should be given any more weight than the ENSR test results in evaluating whether the toxicity of the August 3, 2004 sample actually exceeded the daily maximum WET limit" (Brix dec. ¶15). In essence, Teck Cominco chose to selectively ignore data that indicated a continuing toxicity problem.

At a minimum, an additional test should have been immediately initiated on another sample after the August 3 failure. This is the procedure specified in NPDES permits when toxicity effects

are measured. Statistical testing could have been done on the test results from the two labs to determine whether a failing average had been measured. (Teck Cominco used this approach to its advantage on its 2002 data to try to make a case for the fact that it amended its DMR reports from 1999, 2001, and 2002). Instead, Teck Cominco justified its response by saying that it reviewed its data and operations but could identify nothing that would explain an increase in WET toxicity (Mark Thompson WET dec., ¶¶ 16 and 17). However, a review of the trends shown in the figure below shows that there was a general increase in toxicity in the discharge during 2001 and 2002. This indicates Tech Cominco was drawing conclusions that were not based on solid scientific data nor were they consistent with NPDES requirements which call for an immediate retest of the discharge.



In taking a position favorable to its argument, Teck Cominco was also ignoring the need to initiate a TIE/TRE on the August 3, 2004 sample. As described earlier, Teck Cominco has failed to identify the causes of toxicity observed in prior samples. In its Opposition (at page 66 of 110) Teck Cominco justifies its position by saying it looked at the results of analyses for those parameters regulated under its 1998 permit. As described earlier, Teck Cominco has never identified all of the contaminants causing toxic responses in its discharge in the past. By limiting its analysis of possible

contaminants to only those specified in the permit, Teck Cominco is presupposing that only the regulated contaminants can be responsible for toxicity in its discharge. This is a false presumption. Since the Red Dog discharge is a complex effluent of many chemicals (most of which are not regulated by the permit), this necessitates that a more proactive and broader approach should have been taken once it was known by Teck Cominco that the August 2004 discharge was toxic. EPA anticipated such needs when it developed the WET test and TIE/TRE requirements as part of the NPDES permit. It is a prime example of why EPA has established both numerical and aquatic life standards for discharges. In our experience, we have frequently identified contaminants in discharges that were responsible for toxic effects but which were not regulated in an NPDES permit. This is further evidence that Teck Cominco has failed to undertake the steps necessary to eliminate the problems in its discharge.

Teck Cominco further distorted protocols and reporting procedures in claiming that no permit exceedances occurred in May, June, and July 1999 and in August 2001 and September 2002 (Mark Thompson WET declaration, ¶19). Initially, Teck Cominco had notified EPA at the time of testing that permit exceedances had occurred. Subsequently, it submitted a revised DMR in 2003 claiming that no exceedances had occurred. Teck Cominco based this change in status on the basis of high variability in test results. EPA has addressed variability criteria in WET tests (specifically *Ceriodaphnia* chronic tests, among others) and this is described in *Guidelines Establishing Test Procedures for the Analysis of Pollutants; Whole Effluent Toxicity Test Methods; Final Rule* [Federal Register: November 19, 2002 (Volume 67, Number 223)] [Rules and Regulations] [Page 69951-69972]. I have attached a true and correct copy of this publication as Exhibit 190. The Final Rule says, "Reviewed tests that fail to meet the variability criteria and do not detect toxicity at the receiving water concentration are invalid and must be repeated on a newly collected sample". Note that to apply this criterion to claim an invalid test due to variability, Teck Cominco would have been required to rerun and report a successful test. This was not done which invalidates Teck Cominco's basis for amending its DMRs. Therefore, the original DMR reports must stand which indicate test failures. Further, the Final Rule goes on to say: "...variability criteria have the potential to invalidate highly variable tests. Invalidation, however, is contingent upon other data evaluation steps. For instance, tests that exceed the variability criteria are only invalidated when the test also fails to detect toxicity at the permitted receiving water concentration". Since the tests demonstrated toxicity at levels below the established permit limit (i.e. the receiving water concentration), the variability criteria do not apply for invalidating test results and Teck Cominco wrongly amended its DMRs in March 2003. In so doing, Teck Cominco is erroneously arguing that there have been no violations of their permit.

Teck Cominco has provided an Microsoft Excel spreadsheet which summarizes their chemistry and toxicity test data collected from May 1998 to October 2002. In other words, it covers the period described above where Teck Cominco claimed high variability in the toxicity test data as described above. The toxicity data for this period are summarized in the table below. It is noteworthy in showing that except for the tests run on September 20, 2001, all of the duplicate test series were within the statistical ranges normally experienced with this test. Over this period, eight tests or series of tests (when averaged) exceeded permit toxicity limits (July 6, 2000; August 3, 2000; August 2, 2001; August 16, 2001; June 6, 2002; August 6, 2002; September 7, 2002; and September 24, 2002). Averaging resulted in two passes where one of the two tests was actually a

failure. A review of water quality data for this same period showed similar levels of temporal variability which also suggested that the toxicity variability was an expected result.

TUc			
DATE	Test 1	Test 2	Average
5/27/00	4.9		
6/15/00	6.7		
7/6/00	10.2		
7/22/00	4.9	6.4	5.7
8/3/00	18.4		
8/24/00	7.2	4.9	6.1
9/6/00	6.2		
10/3/00	7.3	4.9	6.1
6/14/01	8.8		
7/5/01	6.4		
8/2/01	24		
8/16/01	35.5		
9/20/01	5.5	93.4	49.5
10/4/01	7.6	5.3	6.5
5/28/02	5.2	4.9	5.1
6/6/02	19.3	6.7	13.0
7/9/02	6.1	10.9	8.5
8/6/02	17.2	6.1	11.7
9/7/02	9.8	28.4	19.1
9/24/02	17	13	15.0
10/3/02	11.8	5.7	8.8

As discussed above, Teck Cominco has shown a consistent pattern of picking and choosing data favorable to its cause while ignoring or discarding data that demonstrate toxic effects. In his declaration, Mr. Brix referred to his studies with Arctic grayling and Dolly Varden eggs to justify a loosening of standards to allow 1500 mg/l TDS limit as protective of these species (paragraphs 16-19). In reaching this conclusion, Mr. Brix also discarded data that were not favorable to his arguments without clear justification or scientific basis for such exclusion (page 21, Brix, K.V. and Martin Grosell, 2005, *Report on the Effects of Total Dissolved Solids on Arctic Grayling and Dolly Varden Fertilization Success*, Report Prepared for Mark Thompson, Teck Cominco).

Teck Cominco argues that the steps being taken "assures continued compliance with WET reporting requirements". In fact, Teck Cominco has been in continuous non-compliance since filing its amended DMR's and will remain so until these are corrected. Furthermore, given the pick and choose data selection employed in the past and which Teck Cominco continues to claim as appropriate for amending its earlier DMRs, it is virtually assured that Teck Cominco will further continue to violate reporting requirements. This will hold true whenever it chooses to report only one set of lab data when two tests are run, fails to initiate a retest when a lab reports a failed test, or claims invalid data because toxicity is shown in a test with high variability. "Continued

compliance" also cannot be claimed due to the fact that Teck Cominco has only identified 50% of the cause of the toxicity in its effluent. Under its NPDES permit, Teck Cominco is obligated to identify and provide treatment to remove any sources of toxicity in its discharge. Until Teck Cominco has conclusively identified the source of the toxicity or instituted the required treatment to eliminate the toxicity, any claims assuring compliance with WET requirements are misstated at best. Measured toxicity in its August 2004 sample shows that Teck Cominco has failed to either identify its toxicant or to develop the necessary treatment to remove the toxicity.

Teck Cominco is arguing in its Opposition that no causation can be demonstrated. In making such a claim, Tech Cominco is failing to acknowledge the fact that its effluent has shown toxicity at extremely low levels in violation of its NPDES permit. The discharge flows into waters that are used by local residents for recreation and fishing. Thompson (depo. at 189:15-190:9) has testified that the Red Dog discharge can be detected at Station 1 from where the citizens of Kivalina get their water. The pollutants discharged by Teck Cominco -- TDS, cyanide, cadmium, among others -- are toxic to aquatic life with the latter two having potential human health effects. This toxicity is measured by the WET test. Under such circumstances, it would be inadvisable for local residents to recreate or utilize these water or eat fish without a complete knowledge of the causes of toxicity in the Red Dog discharge and that these contaminants had been removed from their water supply. In demonstrating a toxic discharge in its WET tests, Teck Cominco had a permit obligation to identify the cause of the toxicity and to take steps to remove such toxicants. Not only has Teck Cominco failed to eliminate the toxicity but it has only been able to identify 50% of the cause of the toxicity in their effluent. Teck Cominco's effluent is made up of potentially dozens of toxicants that can singly or in combination affect the environment and humans. In spite of the fact that Teck Cominco knew its problems with toxicity extended beyond regulated toxicants, it has not complied with the NPDES requirement to identify and remove the source of the problem.

Total Dissolved Solids

Treatment for TDS is possible, and is in fact being done at other mines and water treatment facilities around the world. I disagree with the conclusions of the 1999 Andrews report that there is not enough information regarding the benefit, need and justification for TDS treatment. The effects of TDS on aquatic species is well documented – here, Teck Cominco routinely reports that TDS is responsible for 100% of the toxicity found in the effluent from Outfall 001 – and the effect of high TDS water in other applications (i.e. agriculture and potable water) are well established.

From the expert report of Gene Andrews in this case (November 2004), it appears that the strategy Teck Cominco undertook was to rely on revisions in the state water quality standards and stream re-classifications rather than a pro-active approach to treatment. I note that between his 1997 and 1999 reports, Mr. Andrews shows increases in hardness, TDS and sulfates in the post-mining stream concentrations and the treated effluent.

I have reviewed the DMR and the lab results for TDS for June 1999, July 1999, August 1999, September 1999, and October 1999; May 2000, June 2000, July 2000, August 2000, September 2000, and October 2000; May 2001, June 2001, July 2001, August 2001, September 2001, and October 2001; May 2002, June 2002, July 2002, August 2002, September 2002, and

October 2002; May 2003, June 2003, July 2003, and August 2003; May 2004, June 2004, July 2004, August 2004, and September 2004; May 2005, June 2005, July 2005, August 2005, September 2005 and October 2005; May 2006, June 2006, July 2006, August 2006, September 2006, and October 2006; May 2007, June 2007. The results are shown in the table below. The results are shown in the table below, in mg/L. . I have calculated the annual average by averaging each monthly result.

Monthly Average TDS Concentrations, Outfall 001, 1999-2007 (in mg/L)

	1999	2000	2001	2002	2003	2004	2005	2006	2007
May	2713	3363	n.a.	1710	3580	2747	2997	3433	2770
June	3138	2647.5	3210	2995	3145	3410	3920	3538	3950
July	3210	n.a.	3290	3348	3473	3840	4039	3713	4070
August	3213	3132	2692	3463	3670	3836	4024	3660	--
September	3302	3063	3317	3442.5	n.a.	3770	3897	3943	--
October	3560	3200	3365	3340	n.a.	n.a.	4042	4110	--
Annual Average	3189	3081	3175	3050	3467	3521	3820	3732	3596

I have reviewed the DMR and the lab results for TDS for July 2005. The results are shown in the table below.

	mg/L
July 4, 2005	4090
July 10, 2005	3870
July 19, 2005	4020
July 26, 2005	4174
Monthly Average	4039

I have reviewed the DMR and the lab results for TDS for August 2005. The results are shown in the table below.

	mg/L
August 2, 2005	4122
August 9, 2005	3966
August 15, 2005	3958
August 21, 2005	3996
August 30, 2005	4076

Monthly Average	4024

I have reviewed the DMR and the lab results for TDS for September 2005. The results are shown in the table below.

	mg/L
September 5, 2005	3826
September 12, 2005	3864
September 19, 2005	3934
September 26, 2005	3964
Monthly Average	3897

I have reviewed the DMR and the lab results for TDS for October 2005. The October 3, 2005 TDS result was 4042 mg/L, which is both the daily maximum and the monthly average.

I have reviewed the DMR and the lab results for TDS for May 2006. The results are shown in the table below.

	mg/L
May 11, 2006	4116
May 15, 2006	4154
May 22, 2006	3134
May 29, 2006	2330
Monthly Average	3433

I have reviewed the DMR and the lab results for TDS for June 2006. The tests are summarized in the table below.

	mg/L
June 5, 2006	3580
June 12, 2006	3340
June 19, 2006	3480
June 26, 2006	3750
Monthly Average	3538

I have reviewed the DMR and the lab results for TDS for September 2006. The tests are summarized in the table below.

	mg/L
September 5, 2006	4050
September 10, 2006	3960
September 18, 2006	3880
September 24, 2006	3880
Monthly Average	3943

I have reviewed the DMR and the lab results for TDS for October 2006. The one TDS value reported, for October 1, 2006, is 4110 mg/L, which is both the daily maximum and the monthly average for October.

I have reviewed the DMR and the lab results for TDS for May 2007.

	mg/L
May 26, 2007	2800
May 28, 2007	2740
Monthly Average	2770

I have reviewed the DMR and the lab results for TDS for June 2007. The tests are summarized in the table below.

	mg/L
June 4, 2007	3610
June 10, 2007	4030
June 17, 2007	4000
June 25, 2007	4170
Monthly Average	3950

I expect that given the results from previous years, Teck Cominco will likely have violated its TDS daily maximum permit limit of 3900 mg/L in July, August, September and October 2007, although I have not yet been provided with those DMRs.

Cyanide

Tables are provided below summarizing lab results and reported DMR values for cyanide from the Red Dog mine. ,A "Monthly Average" is shown which was calculated by using the lowest value for each lab for the discrete date reported in the DMR's narrative portion and from lab reports. The narrative portion of the DMR does not include this information. The "Monthly Average Reported in DMR" is the value from the DMR tables for that month. The column the Monthly

Average is reported under corresponds to the specific lab's data Teck Cominco chose to use in the DMR.

The labs used by Teck Cominco to get test results for including in its DMRs include ACZ Laboratories, Inc. ("ACZ"), Columbia Analytical Services, Inc. ("CAS"), CT&E Environmental Services, Inc. (CT&E), North Creek Analytical, Inc. ("NCA"), and Test America.

I have reviewed the DMRs for total cyanide for May 1999, June 1999, July 1999, August 1999, September 1999, May 2000, June 2000, July 2000, September 2000, October 2000, June 2001, July 2001, August 2001, September 2001, May 2002 and June 2002. The monthly average results from the DMRs are summarized in the following table. The monthly averages reported by Teck Cominco in each of these months except for October 2000 violate Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb (and in May 2000 and June 2000 violate Teck Cominco's asserted permit limitation of 9 ppb).

MONTHLY AVERAGE TOTAL CYANIDE VALUES REPORTED IN DMRS	**1999-2002**
Month	Monthly Average Reported in DMR
May 1999	8.3 ppb
June 1999	7 ppb
July 1999	4.75 ppb
August 1999	7 ppb
September 1999	4.8 ppb
May 2000	13 ppb
June 2000	12 ppb
July 2000	5.2 ppb
September 2000	6.0 ppb
October 2000	"<5" ppb
June 2001	9 ppb
July 2001	5.8 ppb
August 2001	8.8 ppb
September 2001	6.7 ppb
May 2002	6.0 ppb
June 2002	4.5 ppb

I have reviewed the DMR and the lab results for total cyanide for May 2000. The results for May 25, 27 and 29 are summarized in the following table. All of the values for both labs violate the daily maximum in Condition I(A)(1) of 9 ppb; the DMR reports the maximum at 16 ppb.

MAY 2000 CN results	CAS	CT&E
May 25, 2000	16 ppb	41 ppb
May 27, 2000		24 ppb
May 29, 2000	16 ppb	29 ppb

I have reviewed the DMR and the lab results for total cyanide for June 2000. The results for June 10, 13 and 24 are summarized in the following table. The monthly maximum reported in the DMR, 19 ppb, violates the daily maximum in Condition I(A)(1) of 9 ppb.

JUNE 2000 CN results	CAS	CT&E
June 10, 2000	8 ppb	12 ppb
June 13, 2000	13 ppb	10 ppb
June 24, 2000		19 ppb

I have reviewed the DMR and the lab results for total cyanide for June 2001. The results are summarized in the following table. The daily results for CAS on June 12, and CT&E on June 14 and June 18, violate the daily maximum permit limitation in Condition I(A)(1) of 9 ppb. The monthly average reported in the DMR violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

JUNE 2001 CN results	CT&E	CAS
June 9, 2001		5 ppb
June 12, 2001		10 ppb
June 14, 2001	10 ppb	
June 18, 2001	12 ppb	5 ppb
June 27, 2001		5 ppb

I have reviewed the DMR and the lab results for total cyanide for July 2001. The results are summarized in the following table. The daily results for July 22 and July 30 violate Teck Cominco's daily maximum permit limitation in Condition I(A)(1) of 9 ppb. The monthly average reported in the DMR violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

JULY 2001 CN results	CT&E
July 22, 2001	10 ppb

July 30, 2001	10 ppb
Monthly Average Reported in DMR	5.8

I have reviewed the DMR and the lab results for total cyanide for August 2001. The results are summarized in the following table. Every single result from CT&E and the August 12 result from CAS violate Teck Cominco's daily maximum permit limitation in Condition I(A)(1) of 9 ppb. The monthly average reported in the DMR violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb. This is true for both labs.

AUGUST 2001 CN results	CAS	CT&E
August 2, 2001	6 ppb	
August 7, 2001	5 ppb	
August 12, 2001	10 ppb	17 ppb
August 13, 2001		13 ppb
August 16, 2001		13 ppb
August 20, 2001	5 ppb	21 ppb
August 26, 2001		20 ppb
Monthly Average Reported in DMR (results from both labs used per DMR)	8.8 ppb	

I have reviewed the DMR and the lab results for total cyanide for September 2001. The results are summarized in the following table. The September 1 CT&E result violates Teck Cominco's daily maximum permit limitation in Condition I(A)(1) of 9 ppb. The monthly average reported in the DMR violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

SEPTEMBER 2001 CN results	CAS	CT&E
September 1, 2001	3 ppb	11 ppb
September 6, 2001	5 ppb	
September 20, 2001	7 ppb	
September 24, 2001	7 ppb	
Monthly Average Reported in DMR (lab not specified)	6.7 ppb	

I have reviewed the DMR and the lab results for total cyanide for May 2002. The reported monthly average of 6 ppb violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

I have reviewed the DMR and the lab results for total cyanide for June 2002. The results are summarized in the following table. The June 10 result violates Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. The monthly average reported in the DMR violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

JUNE 2002 CN results	CAS
June 10, 2002	18 ppb
Monthly Average Reported in DMR	4.5 ppb

I have reviewed the DMR and the lab results for total cyanide for September 2002. The results are summarized in the following table. For those samples analyzed at the CAS lab, five of the ten samples tested over the cyanide daily permit limit of 9 ppb, with test results of 25, 10, 27, 10 and 37 ppb; the average of the 10 tests was 12 ppb. For those analyzed by the CT&E lab, nine of the ten tests were over the cyanide daily permit limit, with results of 28, 16, 23, 17, 24, 31, 22, 27 and 30 ppb, and an average of 22 ppb, more than twice the permit limit in Condition I(A)(1) of 9 ppb.

SEPTEMBER 2002 CN results	CAS	CT&E
September 24, 2002	7 ppb	
September 30, 2002 #1	25 ppb	28 ppb
#2	< 3 ppb	16 ppb
#3	< 3 ppb	23 ppb
#4	10 ppb	17 ppb
#5	3 ppb	24 ppb
#6	4 ppb	31 ppb
#7	4 ppb	< 5 ppb
#8	27 ppb	22 ppb
#9	10 ppb	27 ppb
#10	37 ppb	30 ppb
Average of Split Samples Reported in DMR	12 ppb	22 ppb
Monthly Average Reported in DMR (no lab specified)	1.8 ppb	

I have reviewed the DMR and the lab results for total cyanide for June 2003. The results are summarized in the following table. Conservatively setting "<3" result (June 17) equal to zero, I calculate the CAS monthly average to be 6.3 ppb. Two of the three June 17 results and both June

24 results from CAS lab violate Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. The CAS monthly average violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

JUNE 2003 CN results	CAS	NCA
June 3, 2003	8 ppb	1.52 ppb
June 10, 2003	7 ppb	2.6 ppb
June 17, 2003	10 ppb	2.75 ppb
	25 ppb	
	<3 ppb	
June 24, 2003	10 ppb	0.85 ppb
	13 ppb	
Monthly Average	6.3 ppb	1.93 ppb
Monthly Average Reported in DMR		2.0 ppb

I have reviewed the DMR and the lab results for total cyanide for July 2003. The results are summarized in the following table. Conservatively using the lowest result for July 15 and July 29, the CAS monthly average is 10.25. Both of the July 15 and July 29 results from CAS violate Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. The CAS monthly average violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

JULY 2003 CN results	CAS	NCA
July 1, 2003	8 ppb	<0 .6 ppb
July 8, 2003	3 ppb	<0.6 ppb
July 15, 2003	20 ppb	0.65 ppb
	22 ppb	
July 18, 2003		2.68 ppb
July 29, 2003	12 ppb	3.52 ppb
	10 ppb	
Monthly Average	10.25 ppb	1.71 ppb
Monthly Average Reported in DMR		1.4 ppb

I have reviewed the DMR and the lab results for total cyanide for August 2003. The results are summarized in the following table. The CAS monthly average violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

AUGUST 2003 CN results	CAS	NCA
August 12, 2003	7 ppb	< 0.6 ppb
Monthly Average	7 ppb	<0.6 ppb
Monthly Average Reported in DMR		.04 ppb

I have reviewed the DMR and the lab results for total cyanide for May 2005. The results are summarized in the following table. All three NCA results and the ACZ result on May 23, 2005 violate Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. Conservatively taking the lowest daily results for May 23, the NCA average is 7.47 ppb. Setting the non-detect values for May 14 and May 19 to zero, the ACZ average is 5.67 ppb. Both monthly averages violate Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb. Although Teck Cominco reports in the DMR using ACZ's results in the table, the table value for daily maximum reported by Teck Cominco is "<3" while the actual maximum value reported by ACZ for May 2005 is 17 ppb.

MAY 2005 CN results	ACZ	NCA
May 14, 2005	< 3 ppb (n.d.)	1.42 ppb
(2^{nd} result not reported in DMR)	< 3 ppb (n.d.)	
May 19, 2005	< 3 ppb (n.d.)	3.38 ppb
May 23, 2005	17 ppb	18.5 ppb
(2^{nd} result not reported in DMR)		20.8 ppb
(3^{rd} result not reported in DMR)		17.6 ppb
(4^{th} result not reported in DMR)		23.4 ppb
Monthly Average	5.67 ppb	7.47 ppb
Monthly Average Reported in DMR	<3	

I have reviewed the DMR and the lab results for total cyanide for August 2005. The results are summarized in the following table. Both of the daily results from NCA on August 9, 2005 violate Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. Conservatively taking the lower of the two daily results for August 9, the NCA average is 5.68 ppb, which violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

AUGUST 2005 CN results	ACZ	NCA
August 2, 2005	<3 ppb	4.78 ppb

August 9, 2005	3 ppb	12.8 ppb
(2nd result not reported in DMR)		18.5 ppb
August 15, 2005	5 ppb	5.2 ppb
August 21, 2005	<3 ppb	3.18 ppb
August 30, 2005	<3 ppb	2.42 ppb
Monthly Average	1.6 ppb	5.68 ppb
Monthly Average Reported in DMR	<9	

I have reviewed the DMR and the lab results for total cyanide for September 2005. The results are summarized in the following table. All of the daily results from both labs on September 5, September 12, and September 19, 2005 violate Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. Conservatively taking the lower of the two daily results for each date, and using zero as the input for the non-detect on September 26, 2005, the NCA average is 16.53 ppb. Using the lower result on September 5, 2005, the ACZ average is 8.75 ppb. Both monthly averages violate Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb (and the NCA average violates the limitation of 9 ppb claimed by Teck Cominco). In the DMR table, Teck Cominco reported one exceedance for daily cyanide with a maximum value of 10 ppb.

SEPTEMBER 2005 CN results	ACZ	NCA
September 5, 2005	10	14.2
	22	25
September 12, 2005	10	22.4
	24.5	24.5
September 19, 2005	10	13.0
		13.1
September 26, 2005	5	<0.6 (n.d.)
Monthly Average	8.75 ppb	16.53 ppb
Monthly Average Reported in DMR	<9	

I have reviewed the DMR and the lab results for total cyanide for October 2005. The results are summarized in the following table. The NCA results of 10.8 ppb and 12.3 ppb violate Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. The NCA monthly average of 11.55 ppb and the ACZ monthly average of 9 ppb both violate Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb (and the NCA average violates the limitation of 9 ppb claimed by Teck Cominco). In the narrative portion of the DMR, Teck Cominco reveals that it is reporting the "ACZ

sulfide fixed total cyanide result" in the tables; the sulfide field fixed result from ACZ for October 3, 2005 is 7 ppb, which violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

OCTOBER 2005 CN results	ACZ	NCA
October 3, 2005	9 ppb	10.8 ppb
		12.3 ppb
Monthly Average	9 ppb	11.55 ppb
Monthly Average Reported in DMR	<9	

I have reviewed the DMR and the lab results for total cyanide for May 2006. The results are summarized in the following table. The ACZ daily results of 10 ppb on May 11, 2006 and of 13 ppb on May 15, 2006 violate Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. The ACZ average of 10.25 violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb (and the limitation of 9 ppb claimed by Teck Cominco).

MAY 2006 CN results	ACZ	Test America
May 11, 2006	10 ppb	3.1 ppb
May 15, 2006	13 ppb	2.7 ppb
May 22, 2006	9 ppb	3.8 ppb
May 29, 2006	9 ppb	< 0.6 ppb (n.d.)
Monthly Average	10.25 ppb	2.4 ppb
Monthly Average Reported in DMR		<9

I have reviewed the DMR and the lab results for total cyanide for June 2006. The results are summarized in the following table. The ACZ daily result of 19 ppb on June 5, 2006 violates Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. Conservatively taking the lower of the two test values from ACZ for June 19, 2006, the monthly average of ACZ's results is 10.5 ppb. The Test America monthly average is 5.09 ppb. Both averages violate Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb (and the ACZ average violates the limitation of 9 ppb claimed by Teck Cominco).

JUNE 2006 CN results	ACZ	Test America
June 5, 2006	19 ppb	7
June 12, 2006	8 ppb	2.72 ppb
June 19, 2006	7 ppb	3.15

(2nd sample not reported in DMR)	8 ppb	
June 26, 2006	8 ppb	7.48
Monthly Average	10.5 ppb	5.09 ppb
Monthly Average Reported in DMR		<9

I have reviewed the DMR and the lab results for total cyanide for July 2006. The results are summarized in the following table. Taking the test values from ACZ reported in the DMR for July 4 and July 10, 2006, the monthly average of ACZ's results is 8.0 ppb (conservatively taking the lower of the two value for July 4 and July 10 yields an average of 7.75 ppb, which does not change the overall conclusion about compliance for July 2006). The monthly average of the Test America results is 4.125 ppb. Both averages violate Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

JULY 2006 CN results	ACZ	Test America
July 4, 2006	7 ppb	5.9 ppb
(2nd result not reported in DMR)	6 ppb	
July 10, 2006	8 ppb	3.18 ppb
(2nd result not reported in DMR)	9 ppb	
July 17, 2006	9 ppb	3.78 ppb
July 24, 2006	8 ppb	3.62 ppb
Monthly Average	8.0 ppb	4.12 ppb
Monthly Average Reported in DMR		<9

I have reviewed the DMR and the lab results for total cyanide for August 2006. The results are summarized in the following table. Using the test results reported in the DMR, the ACZ monthly average of 6.2 ppb violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb. (Using a value of zero for the non-detect on August 7, 2006, the monthly average of Test America's five tests is 2.72 ppb.)

AUGUST 2006 CN results	ACZ	Test America
August 1, 2006	6 ppb	3.81 ppb
August 7, 2006	5 ppb	<1.2 ppb (n.d.)
August 14, 2006	8 ppb	3.35 ppb

August 20, 2006	6 ppb	2.55 ppb
(2nd value not reported in DMR)	7 ppb	
August 27, 2006	6 ppb	3.9 ppb
Monthly Average	6.2 ppb	2.72 ppb
Monthly Average Reported in DMR		<9

I have reviewed the DMR and the lab results for total cyanide for September 2006. The results are summarized in the following table. Both labs monthly averages violate Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

SEPTEMBER 2006 CN results	ACZ	Test America
September 5, 2006	7 ppb	6.55 ppb
September 10, 2006	6 ppb	5.08 ppb
September 18, 2006	4 ppb	7.2 ppb
September 24, 2006	4 ppb	2.22 ppb
Monthly Average	5.25 ppb	5.26 ppb
Monthly Average Reported in DMR		<9

I have reviewed the DMR and the lab results for total cyanide for October 2006. The results are summarized in the following table. The Test America monthly average of 9 ppb violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb.

OCTOBER 2006 CN results	ACZ	Test America
October 1, 2006	< 5 ppb	9 ppb
Monthly Average	<5 ppb	9 ppb
Monthly Average Reported in DMR	<5.0 ppb	

I have reviewed the lab results for total cyanide for August 2007. The results are summarized in the following table. The monthly average of ACZ's tests was 6.25 ppb, which violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb. (Using zero as the value for the non-detect on August 6, Test America's tests averaged 3.285 ppb for the month.)

AUGUST 2007 CN results	ACZ	Test America
August 1, 2007		1.28 ppb
		< 0.9 ppb (n.d.)
August 6, 2007	7 ppb	2.98 ppb
	5 ppb	3.68
August 13, 2007	6 ppb	
August 20, 2007	7 ppb	4.65 ppb
		7.12 ppb
Monthly Average	6.25 ppb	3.285 ppb

I have reviewed the lab results for total cyanide for September 2007. The results are summarized in the following table. The results of 20.0 ppb and 37.1 ppb on September 10, 2007 violate Teck Cominco's permit limitation in Condition I(A)(1) of 9 ppb. The Test America monthly average of 10.31 ppb violates Teck Cominco's permit limitation in Condition I(A)(1) of 4 ppb (and violates the limitation of 9 ppb claimed by Teck Cominco).

SEPTEMBER 2007 CN results	Test America
September 10, 2007	20.0 ppb
	37.1 ppb
	2.45 ppb
September 16, 2007	2.42 ppb
	2.82 ppb
September 24, 2007	2.95 ppb
	4.45 ppb
Monthly Average	10.31 ppb

I understand from plaintiffs' counsel that the October 2007 reported monthly average and daily maximum result was 32 ppb, but Teck Cominco did not provide plaintiffs with the October 2007 DMR in time for me to review it before completing this expert report. This result is eight times the monthly average permit limit, and almost four time the daily maximum limit for total cyanide.

Testimony on the Expert Report of Kevin Brix

Kevin Brix misinterprets his own assessment data for cadmium (Expert Report of Kevin Brix, Paragraph 16) to assert that the "effluent is actually providing a substantial benefit to aquatic life downstream of the discharge…". Mr. Brix acknowledges that "the permit limit for cadmium is

based on water concentrations that are protective of aquatic life" (Expert Report of Kevin Brix, Paragraph 9). Exceedances of the limit would indicate a potential for impacting the environment, not improving it. Additional loading of cadmium and other chemical constituents into the system is occurring as a result of the discharge from the Red Dog Mine. Inputs that add more of a toxicant to a system through loading will not reduce toxicity. Loading refers to the mass of a substance that is being added to the Red Dog Creek. Mass loading can have more significance in creating impacts than concentrations. Mr. Brix does not take into account that the discharge is adding more mass of contaminants to the system. This means that the cadmium being added to the system through the Red Dog discharge is further adding to concentrations in the sediments and being made available to downstream waters. Mr. Brix's arguments in his assessment fail to recognize that Teck Cominco has identified only a portion of the possible contributors of toxicity in the discharge. Cadmium is only one of many possible toxic contaminants in the system. EPA has stated: "When whole effluent toxicity testing is used, toxicity itself is a pollutant parameter. The toxicants creating that toxicity need not be specifically identified to limit the effluent's toxicity" *(Whole Effluent Toxicity: Guidelines Establishing Test Procedures for the Analysis of Pollutants*, [Federal Register: October 16, 1995 (Volume 60, Number 199)]. To properly conduct a risk assessment to look at stream impacts from a discharge requires that all possible contributors to toxicity be calculated and summed. Mr. Brix looked only at cadmium in spite of the fact that the discharge is a complex effluent that contains many monitored and unmonitored components. Under EPA's definition, the toxicity in the WET test is a pollutant parameter which has to become a part of any risk assessment. In testing conducted in 2003, Teck Cominco could only account for about 50% of the toxicity in the discharge (Bates #TC 012837 RD, TC 012900 RD, TC 012968 RD, TC 013047 RD). This 50% of the toxicity was attributed to total dissolved solids. There is another 50% of the effluent toxicity which must be considered as a risk to the environment.

It is a gross misstatement for Mr. Brix to claim that the "effluent is providing a substantial benefit to aquatic life downstream of the discharge" (Paragraph 16). The WET test is a violation of the Clean Water Act. No violation of water quality standards can be construed to provide a benefit to the environment.

In his expert report, Mr. Brix evaluates the impacts of TDS from the discharge. TDS is a meaningless term when trying to predict or explain toxicity. TDS is a general measure of the chemical constituents in water. More important than the actual measure of TDS are the actual constituents which make up the TDS. TDS can have significant ecological impacts. Excessive TDS levels can make waters unsuitable for drinking and affect agricultural production when applied in irrigation. The amount of contaminant loading in the aquatic system as a result of TDS discharges from the Red Dog mine has increased from approximately 67,000 pounds per day in the pre-mining period to as much as 809,000 pounds per day in 1995. In 2003, daily input ranged from 274,000 to 780,000 pounds per day. The significance of this loading cannot be overlooked when evaluating the risks of the discharge in producing downstream impacts from the Red Dog discharge. To assume that a system that has acclimated to a loading of 67,000 pounds per day can absorb 4-10 times that much without evaluating all of the possible inputs and the risks of those inputs is not good science.

Teck Cominco has not determined the fate of the discharges from the Red Dog Mine. The sediments are a sink for most contaminants that enter aquatic systems. It is likely that much of the

discharged material has precipitated and been deposited in the bottom sediments (i.e. bottom substrate) where it accumulates and becomes a long-term source of impact. This can directly affect benthic organisms through alteration of habitat and/or community structure. Arctic grayling and dolly varden deposit their eggs on the bottom where they remain exposed to the sediments for periods ranging from 13-18 days for Arctic grayling and up to 4-5 months for the dolly varden. These embryos will be at risk to impact from exposure to the altered sediments resulting from the mine discharge.

Kevin Brix makes further claims that cyanide is not a factor in causing toxic contributions to the stream without producing any data to substantiate his claims. This is in spite of the fact that the mine has been cited for violations for exceeding its cyanide limits and in spite of the fact Teck Cominco has only been able to account for 50% of its toxicity in the WET test. Until it can be proven otherwise, cyanide has to be considered one of many possible contributors of toxicity in the mine discharge.

Kevin Brix' expert report states that metals, cyanide, and milling reagents have been eliminated as causing toxicity in the discharge (Paragraph 34). However, no data have been provided showing how these conclusions were reached. These data have been requested from Teck Cominco by the Plaintiff's counsel.

Under its NPDES permit, Teck Cominco is required to identify and treat all sources of toxicity in its discharge. It should be noted that even though Teck Cominco's discharge does not always exceed its WET permit limits, a passing WET test does not mean Teck Cominco is not discharging toxic materials. In fact, Teck Cominco is reporting a toxic response in every WET test it conducts. During a month when the discharge passes, this generally averages approximately 6 toxic units (t.u.'s). This level of toxicity is indicative of a highly toxic mixture when considered by itself. This equates to a mixture that is toxic at a concentration of only 17% of the effluent. Violations occur at concentrations equivalent to 9.7 t.u.'s or a concentration of about 10-11% effluent. This represents a chronic and continuing discharge of toxics into an environment whose carrying capacity to absorb the load of a complex mixture of contaminants has not been determined. Teck Cominco's assessment of risks from cadmium and cyanide did not take into account the long-term impacts of these toxic inputs to the system.

In his expert testimony, Mr. Brix challenges the use of *Ceriodaphnia dubia* as being representative of resident biota of the Red Dog ecosystem. This is a misinterpretation of WET testing objectives and reasons for *Ceriodaphnia* being selected as the species of choice for WET testing. In reality, there is no one species that would ever be representative of every aquatic habitat in the U.S. Rather, *Ceriodaphnia* is a species that has moderate sensitivities to most contaminants, is easy to culture, and has a short life span which allows it to be used in chronic type investigations. EPA does allow the use of alternative species in WET testing. This is specified in Section 6.1.5 of *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition, October 2002*. However, it should also be noted that this section says: "*Where states have developed culturing and testing methods for indigenous species other than those recommended in this manual, data comparing the sensitivity of the substitute species and the one or more recommended species must be obtained in side-by-side toxicity tests*

with reference toxicants and/or effluents, to ensure that the species selected ***are at least as sensitive*** *as the recommended species*" (**Bolding** added). Any other species which is used would show the same type of response as the *Ceriodaphnia*. Therefore, there is no basis for Teck Cominco to make the claim that its WET tests are overpredicting the potential for impacts on aquatic life as claimed in Keven Brix' expert testimony (Paragraph 35).

In his expert report, Kevin Brix challenges the accuracy of WET tests conducted by Teck Cominco prior to 2003 (Paragraph 39). However, the accuracy of WET tests were addressed in EPA's July 2000 guidance document *Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing(40 CFR Part 136),* EPA-B-00-004 and was available to Teck Cominco at the time of their tests. In addition, this document included guidance for reporting on tests that provided anomalous results that could falsely identify toxicity and for the addition of test dilutions to improve accuracy of suspected results. It also provided for the use of receiving water as dilution water when the objective was to determine the toxicity of an effluent in the receiving system. To our knowledge, Teck Cominco did not avail themselves of this guidance and opportunities to improve their tests. Therefore claims that testing is invalid and the results are inaccurate in measuring toxicity have no merit.

In his expert report, Kevin Brix claims that only substantial changes have validity in assessing impacts in a system. The preponderance of the evidence indicates that impacts have indeed occurred. This is demonstrated by the fact that violations of limits for cyanide, cadmium, TDS, and WET have all occurred. Each of these limits was established to protect water quality and aquatic life and to meet the Clean Water Act's national goal that "the discharge of toxic pollutants in toxic amounts be prohibited". The lack of ability to determine the nature of the toxicity from the Red Dog effluent and the sheer amount of loading that is occurring on a daily basis in the watershed makes any statement denying possible effects of the discharge to be without merit.

Water quality limits have been established to protect human health and aquatic life. The EPA established the NPDES permit system as a means to administer the objectives of the Clean Water Act. NPDES permits establish compliance with the Clean Water Act at the point of release into the environment. When established water quality limits are exceeded at the point of release, then a threat to human health and the environment exists. The amount of loading from the Red Dog discharge indicates that this threat has probably been reflected in impacts to the waters and sediments of the watershed.

Testimony on the Expert Report of Joyce Tsuji

As described above, the discharge from the Red Dog Mine has the potential to contain a wide range of toxic constituents. Some of the contaminants discharged from the Red Dog mine have been assigned water quality limits under Section 304(a) of the Clean Water Act. A larger percentage of the constituents in the Red Dog discharge have not been assigned water quality limits and/or are not monitored. The lack of an established standard does not mean that a particular contaminant does not have human health effects. Lack of a requirement to monitor also does not mean that a contaminant is not present. As already demonstrated, Teck Cominco has only been able to account for 50% of the toxicity present in the WET tests.

Teck Cominco's discharge represents a potential health risk to the citizens of Kivalina who take their water from the Wulik River. The residents of Kivalina also take and eat fish from the Wulik River and Ikalukrok Creek. The Ikalukrok receives drainage from Red Dog Creek. Fish have the ability to accumulate the organic and inorganic toxicants discharged from the Red Dog mine. Exposed fish can uptake the toxicants directly from the stream waters or from their food sources that can also accumulate the toxicants.

The residents of Kivalina are exposed to contaminants from the Red Dog mine through their drinking water or their food including fish. Joyce Tsuji evaluated the risks to the residents of Kivalina from cyanide, cadmium, and TDS. However, these are only a few of many contaminants in the Red Dog discharge. As described in Paragraph 3 and 4 of this report, the discharge from the Red Dog mine includes a wide range of organic and inorganic contaminants, most of which are not monitored. WET tests produced violations of the Red Dog mine NPDES permit. EPA considers the effluent used in the WET tests to be a "pollutant" (i.e. having the same status as an individual contaminant which violates limits). Teck Cominco has accounted for only 50% of the sources of toxicity in the WET samples. It is possible that some of the unidentified toxicants causing WET violations are also toxic to humans. Risk assessment protocols include summing risks from all possible threats. Ms. Tsuji limited her assessments to only cyanide, TDS, and cadmium when it should have considered the much broader range of contaminants potentially present in the system, especially since EPA has assigned a failing WET test as a pollutant no different than a specific contaminant.

In performing her assessment of risks from the Kivalina water system, Ms. Tsuji based it upon water that was stored in the system in August 2002 but was not analyzed until December 2002. Technically, this was not a representative sample of what the residents are exposed to in the summer months when the mine is discharging. From an analytical standpoint, holding times for waters stored in August had been exceeded for all contaminants in the discharge by the time the analysis was done in December. Therefore, while a case could be made that this was the water Kivalina residents drink during the winter, it is not valid as a sample to represent summertime usage.

Joyce Tsuji also conducted an evaluation of risks on the community of Kivalina from fish. This assessment was based on Dolly Varden collected from the Wulik River in the spring and fall. She reported that cadmium was found in liver and other organs but not in fish tissue. She did not report on risks associated with other contaminants discharged from the Red Dog mine even though these are known to be numerous.

Ott and Morris (2004) reported on their results of whole body metals analysis of Dolly Varden in the Red Dog drainage in 2002. They compared tissue concentrations of cadmium, lead, selenium, and zinc from fish from the Red Dog drainage and other streams in Alaska. The Mainstem Red Dog was the only stream to score high on all of the sampled metals. Also, while the average concentration of cadmium in Dolly Varden in 2002 was less than that measured in baseline investigations in 1981 before the beginning of mining (Dames and Moore 1983), concentrations of lead and zinc in the fish tissues were much higher in 2002 than before mining began. Ott and Morris (2004) also found high levels of selenium in the fish. Selenium was not monitored in the 1981 study. These contaminants were not considered in Joyce Tsuji's assessment. Ms. Tsuji also

did not report on the potential risks to human health from fish obtained in Red Dog Creek below the mine or the Ikalukrok Creek. During their lives, Dolly Varden and other fish below the Red Dog mine will migrate up and down the rivers where they will be exposed to the effluent from the mine. Since the Kivalina residents will eat these fish, any assessment of risks should have taken this into consideration. Combined with her failure to consider other toxicants discharged from the mine and the failure to look at a representative water sample, the assessment conducted by Joyce Tsuji was incomplete and did not adequately treat the potential risks to the Kivalina citizens.

The fact that I have focused only on certain statements in the report of Kevin Brix and Joyce Tsuji does not reflect my acceptance or agreement with those statements not specifically addressed here. I reserve the right to modify and supplement my opinions as further information becomes available, including through deposition of defendant's experts, and to express new opinions in response to new information or to opinions expressed by defendant's experts. Additionally, I have not been given access to several of the reports and publications on which Kevin Brix and Joyce Tsuji relied in making their expert opinion; I have been informed by plaintiffs' counsel that these documents were requested of Teck Cominco but have not been provided to plaintiffs. I reserve the right to modify and supplement my opinions once I have been provided all data and publications on which defendant's experts relied.

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